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ABSTRACT

The major purposes of the study were to determine (1) the extent to which students receiving College Level Examination Program (CLEP) credit in mathematics pursue courses in the disciplines, (2) their achievement in advanced mathematics courses compared to other students of similar academic ability, and (3) the potential loss of course credit hours which otherwise may have been generated. It was found that the policy for awarding credit was educationally sound and the potential loss of course credit hours was probably no more than 20 per cent of the total awarded. (Author/RC)

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# EDUCATIONAL AND INSTITUTIONAL EFFECTS OF AWARDING CREDIT FOR THE CLEP GENERAL EXAMINATION IN MATHEMATICS

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The emergence of the College Level Examination Program (CLEP)--the General Examinations (GEs) in particular--has made credit-by-examination a viable option for significant numbers of students. However, institutional attempts to evaluate local policies for awarding credit have been minimal and have paid little attention to the subsequent course work and achievement of students who receive CLEP credit. In the Grandy and Shea (1976) survey 20 per cent of the respondents (all with CLEP policies) reported having conducted studies related to the GEs and less than 15 per cent indicated having done any research on the nature of the later course work and achievement of students receiving credit. In the studies which had been done students generally tended to pursue further course work in the areas of CLEP credit with the exception of Social Science/History, and, in terms of overall achievement, generally received significantly better grades, although the extent to which academic aptitude was controlled is questionable. In addition to these educational issues there is the management question of impact on academic departments in terms of loss of credit hours. Failure to attend to this faculty concern is tantamount to ignoring the political reality of the decision-making structure in formulating policies for credit-by-examination. This study examines both the educational and the management issues as they relate to the CLEP GE in mathematics.

The present CLEP policy at our institution was adopted in 1972. According to that policy students may earn a maximum of 6 hours credit for each of four General Examinations: Natural Science, Mathematics, Humanities, and Social Science/History.[1] (The criterion score is approximately 490 for each GE.) Since the policy was implemented, approximately 3800 students, predominantly new freshmen, have taken the GEs. Earlier institutional studies have shown that a typical CLEP candidate will attempt 3 of the 4 GEs. Although academic ability, as measured by the ACT Composite standard score, was similar for the groups of students registered for each GE, the passing rates varied considerably--from a high of 71 per cent in Mathematics to a low of 39 per cent in Humanities. (For a discussion of the relationship between ACT and CLEP performance, see Halinski and Vogel, in press.) The relatively high passing rate in mathematics raised questions regarding the educational efficacy of the CLEP policy with regards to mathematics and the potential impact of the policy upon the Department of Mathematics. Specific questions addressed were:

(1) For students receiving CLEP credit in mathematics, how does the number of college mathematics course hours registered for and completed compare to that of other students?

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[1]There are no restrictions as such on which courses students with CLEP credit can take. The policy statement reads: "Students who are awarded credit in one or more areas of the General Examinations are expected to consult with their advisors to determine which basic courses and which advanced courses are most appropriate to meet their educational needs."

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(2) For those students who receive CLEP credit in mathematics and pursue subsequent coursework in the subject, how does their performance compare with that of other students?

(3) What is the potential annual loss in credit hours to the Department of Mathematics under the present policy?

## Procedure

A data base was created for 3486 students admitted to ISU directly from high school for the fall of 1973. The data base consisted of a student's ACT standard scores, sex, major in the fall of 1973, major in the spring, 1976, mathematics courses registered for and completed by semester through the spring of 1976 (listed by course number and credit hours), mathematics course grades, CLEP standard score in mathematics (when applicable) and the amount of CLEP credit awarded in mathematics. The mathematics courses were also divided into Level I and Level II courses. Level I courses were defined as those beginning courses normally enrolled in by non-mathematics majors, e.g. Foundation Topics in Mathematics, Applications of Elementary Mathematics, Modern College Algebra with Trigonometry, Finite Mathematics for Business and Social Sciences. Courses requiring competence beyond this level were defined as Level II courses. For convenience, students receiving 6 hours of CLEP credit in mathematics were labeled the "CLEP Group". All students without CLEP credit in mathematics were labeled the "Non-CLEP Group".

Comparisons were made using three designs. In Design I the sample of 3486 students was partitioned into two groups: CLEP and Non-CLEP. In Design II a subsample was taken from each of these groups, the condition for selection being that the student's ACT Mathematics standard score was 25 or greater (ACTM$\geq$25). (As a point of reference, this cutoff score eliminated the bottom two-thirds of the freshman class from the analysis, almost all of whom were in the Non-CLEP group.) In Design III 211 CLEP students from the original sample were matched by ACTM score, sex and major (as of the Spring, 1976 semester) to Non-CLEP students.

Once the data base had been created, a simple tabulation provided the results for describing the number of mathematics course hours enrolled for and completed by level.

The question relating to performance was dealt with in two ways for Designs I and II. First, a t-test for independent groups was used with mathematics GPA as a dependent variable. This was followed by a multiple regression analysis with mathematics GPA again the dependent variable and ACTM, SEX and GROUP (CLEP vs Non-CLEP) as the independent variables. This full model was compared to a reduced model in which the GROUP variable was deleted to test for the significance of the difference in GPA. In Design III a t-test for dependent groups was used. Since no specific number of course hours in mathematics is required, all students did not have a mathematics GPA and only those who did were included in these comparisons. Further, in Design III if one member of a matched pair did not have a mathematics GPA, that pair was deleted from the analysis.

To estimate the potential loss in credit hours to the Department of Mathematics in Designs I & II, it was first determined what percentage of Non-CLEP students had not registered for any hours of mathematics course work for each ACTM unit score interval. Then for the Non-CLEP students who had

registered for mathematics courses, the course hours were regressed on ACTM score and SEX. The regression equations were then applied to the appropriate CLEP groups to estimate the number of hours of course work expected if all CLEP students registered for courses. Under the assumption that without the proficiency credit the proportion of CLEP students at each ACTM score interval not registering for courses would be the same as that for the Non-CLEP students, an estimate was made of the proportion of CLEP students who would not be expected to enroll in any mathematics courses. (There were separate estimates for Designs I and II.) The hours calculated through the regression equations were then reduced by these proportions. The hours thus calculated were then compared to the actual hours registered for. In Design III the estimate of potential loss was more straightforward: The CLEP and Non-CLEP groups were directly compared in terms of mathematics course hours registered for.

## Results and Discussion

The results in Table 1 show that the CLEP group was markedly superior to freshmen in general in terms of developed mathematical ability and overall

Table 1. Sample Size, ACT Results and Proportion of Females for Each of Three Designs

| | Sample Size | Prop of Females | Mean No. of Semesters in School | ACT Math Mean | ACT Math SD | ACT Comp Mean | ACT Comp SD |
|---|---|---|---|---|---|---|---|
| Design I (Entire Sample) | | | | | | | |
| CLEP | 342 | .59 | 5.2 | 29.1 | 3.2 | 26.7 | 2.6 |
| Non-CLEP | 3,144 | .62 | 4.5 | 20.6 | 6.5 | 20.5 | 4.9 |
| Design II (ACTM 25) | | | | | | | |
| CLEP | 309 | .60 | 5.3 | 29.6 | 2.4 | 26.9 | 2.3 |
| Non-CLEP | 917 | .54 | 4.8 | 28.0 | 2.2 | 24.7 | 2.9 |
| Design III (Matched Pairs) | | | | | | | |
| CLEP | 211 | .63 | 6.0 | 28.7 | 3.1 | 26.5 | 2.7 |
| Non-CLEP | 211 | .61 | 6.0 | 28.4 | 2.9 | 25.3 | 2.8 |

academic ability (Design I). For the CLEP group the mean ACT Mathematics score was 29.1 and the mean ACT Composite was 26.7. For the Non-CLEP students, the respective means were 20.6 and 20.5. Additionally, the variability in the scores of the Non-CLEP group along these two dimensions was twice as large as that for the CLEP group. These differences in the two groups, along with a concern for the effect of a student's major on the dependent variables, motivated the parallel analysis in Designs II and III. It can be observed that by going to Design II, the two groups were more nearly comparable with only 10 per cent of the original CLEP sample being lost. Design III provides a control on major with near equality on the ACTM dimension but at a loss of 38 per cent of the original CLEP sample. It is also of interest to note that the mean number of semesters in school is higher for the CLEP group in Designs I

and II. This is consistent with other institutional studies conducted which showed that students who received CLEP credit were more likely to remain at the university. (This phenomena does not show up in Design III since students were matched on their Spring, 1976 major which was considered to be a more definite commitment to a field of study than the major upon entrance to the university.)

In terms of course hour registration, the results in Table 2 show that a CLEP student registers for and completes, on the average, more hours of

Table 2. Mathematics Coursework for CLEP and Non-CLEP Groups

| | No. of Course Hours | | % of Registered Hours | |
|---|---|---|---|---|
| | CLEP | Non-CLEP | CLEP | Non-CLEP |
| Design I (Entire Sample) | | | | |
| Level I (Completed Hours) | 384 | 6,913 | 19% | 49% |
| Level II (Completed Hours) | 1,286 | 3,954 | 63 | 28 |
| Withdrawals/Incompletes | 358 | 3,218 | 18 | 23 |
| Registered Hours | | | | |
| Total | 2,028 | 14,085 | 100% | 100% |
| Mean | 5.93 | 4.48 | | |
| Completed Hours | | | | |
| Total | 1,670 | 10,867 | | |
| Mean | 4.88 | 3.46 | | |
| Design II (ACTM≥25) | | | | |
| Level I (Completed Hours) | 315 | 2,157 | 17% | 38% |
| Level II (Completed Hours) | 1,242 | 2,634 | 67 | 46 |
| Withdrawals/Incompletes | 304 | 878 | 16 | 16 |
| Registered Hours | | | | |
| Total | 1,861 | 5,669 | 100% | 100% |
| Mean | 6.02 | 6.18 | | |
| Completed Hours | | | | |
| Total | 1,557 | 4,791 | | |
| Mean | 5.04 | 5.22 | | |
| Design III (Matched Pairs) | | | | |
| Level I (Completed Hours) | 255 | 638 | 21% | 40% |
| Level II (Completed Hours) | 770 | 785 | 63 | 49 |
| Withdrawals/Incompletes | 196 | 168 | 16 | 11 |
| Registered Hours | | | | |
| Total | 1,221 | 1,591 | 100% | 100% |
| Mean | 5.79 | 7.54 | | |
| Completed Hours | | | | |
| Total | 1,025 | 1,425 | | |
| Mean | 4.86 | [illegible]75 | | |

mathematics than the typical Non-CLEP student, with the bulk of the courses being Level II (Design I). When the analysis is confined to students with ACTM scores of 25 or greater (Design II), the CLEP students, again on the average, register for and complete almost as many course hours as the Non-CLEP students. However, in Design III there is a marked difference between the two groups in the course hours registered for and completed with the advantage favoring the Non-CLEP students. In all three designs, though, there is a stronger tendency for CLEP students to take Level II courses which is in keeping with the rationale that the student's program should build upon the proficiency credit and not duplicate it.

With respect to performance in mathematics courses without controlling on ACTM and SEX (see Table 3), the mean GPA of the CLEP students is significantly

Table 3. Performance in Mathematics Courses as Measured by Mean GPA

| | Sample Size | Mean | Std. Dev. | t |
|---|---|---|---|---|
| Design I (Entire Sample) | | | | |
| Level I Courses | | | | |
| CLEP | 91 | 2.91 | 1.06 | 6.19* |
| Non-CLEP | 1,588 | 2.18 | 1.10 | |
| Level II Courses | | | | |
| CLEP | 138 | 2.83 | 1.17 | 1.65 (n.s.) |
| Non-CLEP | 636 | 2.67 | 1.03 | |
| Level I & II Courses Combined | | | | |
| CLEP | 194 | 2.80 | 1.08 | 6.97* |
| Non-CLEP | 1,805 | 2.23 | 1.14 | |
| Design II (ACTM$\geq$25) | | | | |
| Level I Courses | | | | |
| CLEP | 77 | 2.93 | 1.06 | 1.90 (n.s.) |
| Non-CLEP | 510 | 2.70 | .99 | |
| Level II Courses | | | | |
| CLEP | 130 | 2.85 | 1.14 | 0.86 (n.s.) |
| Non-CLEP | 377 | 2.76 | .99 | |
| Level I & II Courses Combined | | | | |
| CLEP | 176 | 2.81 | 1.13 | 1.62 (n.s.) |
| Non-CLEP | 685 | 2.68 | .96 | |
| Design III (Matched Pairs) | | | | |
| Level I & II Courses Combined | | | | |
| CLEP | 117 | 3.01 | .99 | 1.16 (n.s.) |
| Non-CLEP | 117 | 2.87 | .89 | |

*$p < .001$

higher ($p < .001$) than that of Non-CLEP students for Level I courses and for Level I and II courses combined. The GPA in Level II courses was also higher for the CLEP group, but the difference was not considered to be statistically significant. With partial control on ACTM (Design II), the mean GPA for CLEP students was higher for Level I courses, Level II courses, and Level I and II combined; but, again, the differences were not considered to be statistically significant. With control on ACTM, Sex, and Major (Design III), the GPA for the CLEP students was higher for Level I and II combined; but, once again, the difference was not statistically significant. Comparisons were not made in Design III for Level I courses and Level II courses separately because pairwise deletion when one GPA was missing resulted in unduly small sample sizes.

The regression results in Table 4 show that in both Designs I & II the mean GPA in mathematics is significantly related to ACTM, SEX, and GROUP membership for Level I courses, Level II courses and Level I and II courses combined ($p < .001$). However, examination of the F-values for the GROUP regression weight shows that variable could be deleted from the model without significantly reducing the multiple R-values in each instance. In other words when controlling for differences in ACTM and Sex, there is no significant difference in mean GPA between the CLEP and Non-CLEP groups.

What these results in Tables 3 and 4 suggest is that CLEP students generally do as well in their mathematics coursework as do other students of

Table 4. Regression Results for Comparison of Mean GPA's When Controlling for ACTM and Sex

| | | DESIGN I | | | | | DESIGN II | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Courses | Variables | N | b | F[a] | R[b] | F[c] | N | b | F[a] | R[b] | F[c] |
| Level I & II (combined) | | 1865 | | | .46 | 165.9* | 847 | | | .30 | 28.5* |
| | ACTM | | .08 | 419.2* | | | | .08 | 33.1* | | |
| | SEX | | .39 | 71.5* | | | | .50 | 57.0* | | |
| | GROUP | | .00 | 0.0 | | | | -.02 | 0.0 | | |
| Level I | | 1563 | | | .47 | 145.4* | 579 | | | .30 | 19.1* |
| | ACTM | | .08 | 376.6* | | | | .10 | 25.4* | | |
| | SEX | | .31 | 35.8* | | | | .46 | 31.3* | | |
| | GROUP | | .16 | 2.1 | | | | .07 | 0.3 | | |
| Level II | | 731 | | | .35 | 33.5* | 497 | | | .31 | 17.6* |
| | ACTM | | .04 | 25.7* | | | | .07 | 12.5* | | |
| | SEX | | .66 | 83.0* | | | | .58 | 42.8* | | |
| | GROUP | | -.09 | 0.8 | | | | -.08 | 0.5 | | |

[a]The F refers to the test of significance for the regression weight
[b]The R-value is for the full model
[c]The F refers to the test of significance for the full model R-value
*$p < .001$
Note: In the vector SEX, 1=Female, 0=Male
In the vector GROUP, 1=CLEP, 0=Non-CLEP

similar academic ability. Further, when the performance data is viewed in the context of the course registration data, the relatively small amount of Level I coursework taken by CLEP students does not impair their performance in Level II coursework. It also appears evident that studies which compare the performance of CLEP and Non-CLEP students must take into account the initial ability levels of the two groups. Otherwise the case for the CLEP students will generally be overstated.

The last question to be addressed is the potential credit hour loss to the Department of Mathematics. For Design I & II the estimated hours of mathematics course registration ($\hat{y}$) was calculated as follows:

$$\hat{y}=q*N\ (b_0+b_1*\overline{ACTM}+b_2*\overline{SEX})$$

where q=estimated proportion of CLEP students expected to register for mathematics courses
N=number of students in the CLEP group
$b_0$, $b_1$, $b_2$=raw regression weights derived from the Non-CLEP group
$\overline{ACTM}$=mean ACTM for the CLEP group
$\overline{SEX}$=proportion of females in the CLEP group

For Design I, the calculation was

$$\hat{y}=.833*342\ (5.50+.121*29.1-2.50*.59)$$
$$\hat{y}=2150$$

For Design II, the calculation was

$$\hat{y}=.841*309\ (-7.38+.584*29.6-2.37*.60)$$
$$\hat{y}=2200$$

The comparison of estimated hours and actual hours is presented in Table 5. In Design I the CLEP students registered for 6 per cent fewer hours than estimated; in Design II, 15 per cent fewer hours; and in Design III, 23 per cent fewer hours. Design I most likely underestimates considerably the mathematics course hours CLEP students would take had they not had the CLEP credit, the reason being that the estimating formula is heavily influenced by students with lower ACTM scores and these students tend to take fewer mathematics courses. On the other hand Design III somewhat overestimates the potential loss of hours to the department since it does not take into account the greater holding power of the university for the CLEP group. (This results from matching on spring 1976 major.) Given these considerations our conclusion is that the CLEP students, as a result of the proficiency credit received, take 15-20 per cent fewer hours in Mathematics than they otherwise would.

In summary, the awarding of CLEP credit in mathematics did not result in a large scale avoidance of college courses in the discipline by students receiving the credit. These students were a highly selective group in terms of developed mathematical ability and compared favorably to other students of similar academic ability in terms of course enrollment in mathematics and course completion. While some opted for no further work in the area, it was essentially the Level I courses which were bypassed. Where students did

Table 5. Estimates of the Potential Loss of Credit Hours to the Department of Mathematics

| | Mathematics Course Hour Registration | | | |
|---|---|---|---|---|
| | CLEP (Estimated Hours) (1) | CLEP (Actual Hours) (2) | Diff (3)=(1)-(2) | % Loss (3)÷(1) |
| Design I | 2150 | 2028 | 122 | 6 |
| Design II | 2200 | 1861 | 339 | 15 |
| Design III[a] | 1591 | 1221 | 370 | 23 |

[a]In Design III the estimated hours for the CLEP group is the actual course hour registration for the Non-CLEP group.

pursue further course work in mathematics--and the majority did--the general tendency was to enroll directly in Level II courses with apparently no deleterious effects on their achievement. Finally, it was estimated that the loss in credit hours to the Department of Mathematics amounts to 15-20 per cent of the hours the CLEP students would have been expected to generate had no proficiency credit been awarded.

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